Effects of observing hand motor action on number processing: an online study

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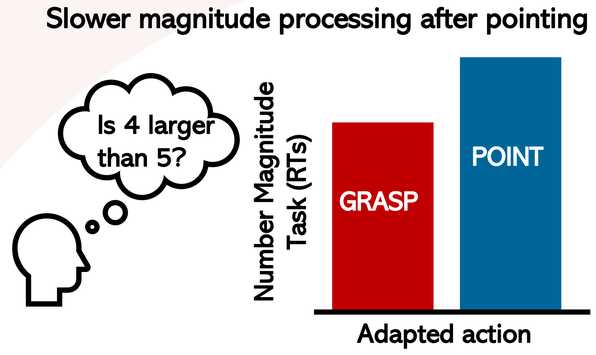
Introduction

A large body of evidence indicates that **processing numbers recruits sensorimotor mechanisms** of hand action [1]. For instance, observing or executing hand motor actions, such as pointing or grasping, modulates performance in tasks involving the explicit or implicit processing of **number magnitudes** [e.g., 2-4].

In a recent study, we used **motor adaptation** to investigate the effects of hand action on the performance in a following number magnitude task [4]. We found that **pointing** as compared to **grasping** (and control conditions) slowed down response latencies in number magnitude comparison.



Schematic representation of results of [4].

Aim of the study

We learn to list and count through pointing: therefore, point might share with numbers **mechanisms for order processing**. Again, we need to estimate object size during grasping: therefore, grasp and number might share **mechanisms for magnitude processing**.

In this study we hypothesized that observing hand **pointing might enhance the processing of number ordinality**, while observing hand **grasping might enhance the processing of number magnitude**.

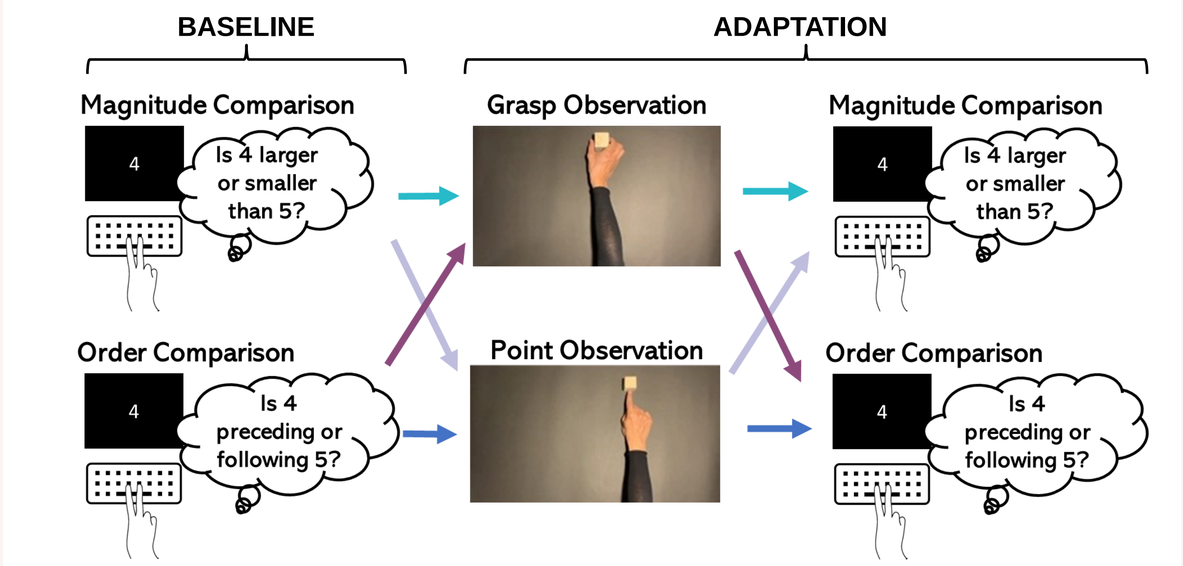
Methods

The method was **preregistered** on the Open Science Framework (OSF).

Participants. The data from 173 adults (mean age = 23 y/o, 128 F) were considered for the analyses. Each participant was assigned to one of the following four conditions:

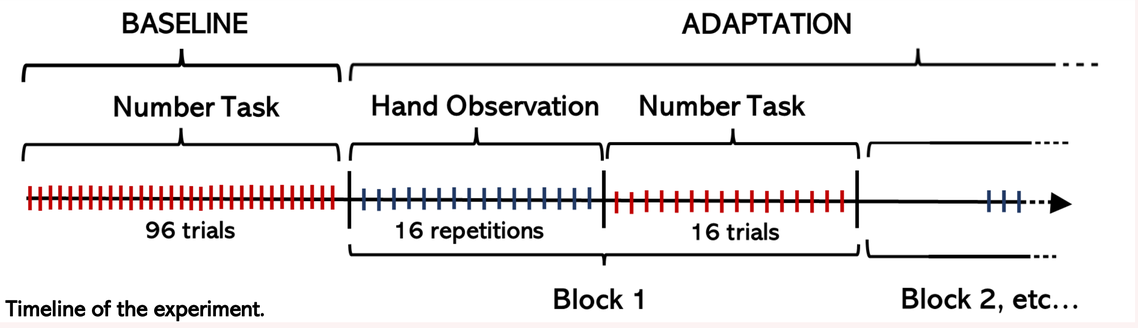
- N = 32 in the Pointing & Magnitude Comparison condition;
- N = 56 in the Grasping & Magnitude Comparison condition:
- N = 35 in the Pointing & Order Comparison condition:
- N = 50 in the Grasping & Order Comparison condition.

Materials



Representation of materials and conditions. The four conditions are indicated by the coloured arrows.

Procedure. The data were collected **online**. Each participant did baseline numerical trials prior to six adaptation blocks. Within each adaptation block, numerical trials were preceded by hand action observation. Number targets were all digits w/o 5.



Timeline of the experiment.

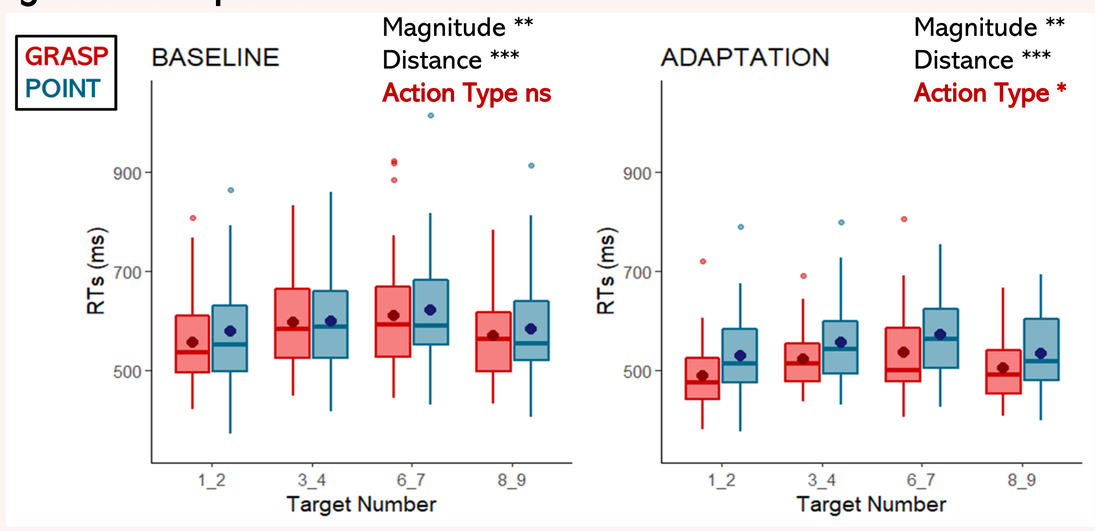
Results

RTs were analysed by means of **frequentist and Bayesian ANOVA**:

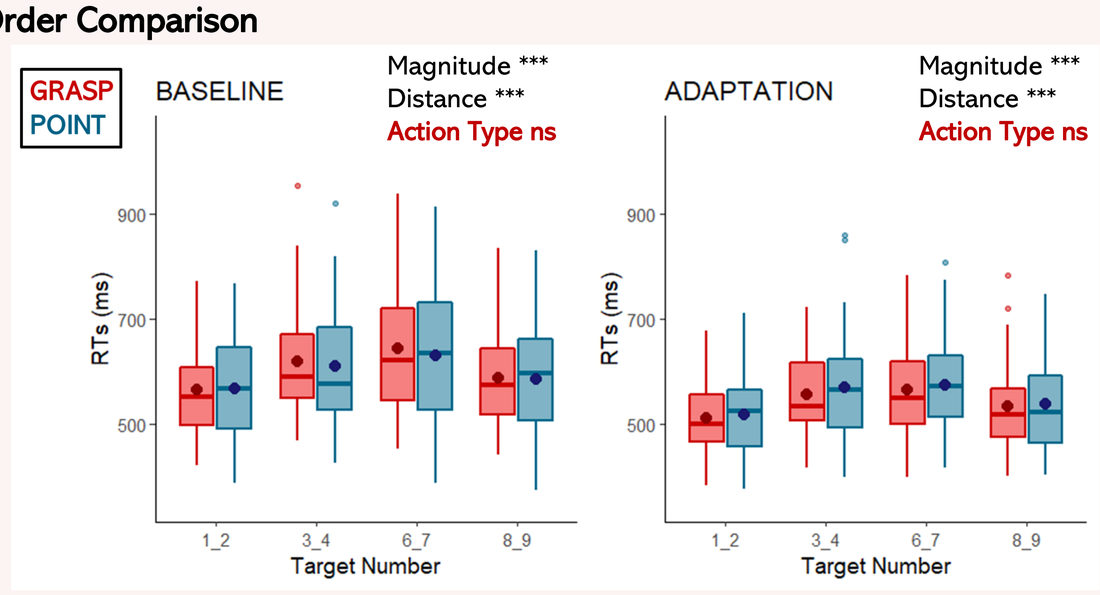
→ Within-subject factors: Magnitude/Order (small/before: 1-4; large/after: 6-9); Distance (close: 3-4, 6-7; far: 1-2, 8-9).

→ Between-subjects factors: Action Type (Point, Grasp).

Magnitude Comparison



Order Comparison



* = p<.05, BF>3; ** = p<.01, BF>3; ***= p<.001, BF>3; ns = p>.05, BF<1.

Conclusion

In number magnitude comparison, response times were **slower after observing hand pointing** as compared to grasping. However, the current analyses did not reveal enhanced performance in the order task after pointing.

Overall, these results suggest that **hand actions can modulate different and specific aspects of numerical processing** [1-4].

References. [1] Ranzini, M., et al. (2022). *Cortex, 148*, 31-67. [2] Badets, A., & Pesenti, M. (2010). *Cognition, 115(1)*, 46-53. [3] Grade, S., et al. (2017). *Psychological research, 81(3)*, 538-548. [4] Ranzini, M., et al. (2022). *PLOS ONE, 17(6)*, e0269557.

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Grasping and Reaching in Number Processing